Action Research:
ASSESSING AND DECREASING PLANT BLINDNESS THROUGH THE INITIAL STAGES OF A RESTORATION PROJECT

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Introduction

A new group of students settled into their seats to begin their tenth grade year of high school Biology and were directed to browse the Biology text in front of them and individually choose a picture that interested them. After choosing a picture students interviewed the person next to them to gain insight about their new lab partner, and prepare a brief summary of the chosen picture. Class introductions followed, and a trend emerged: all of the chosen pictures were described as animals. No pictures of plants were chosen, and in images of both plants and animals, students failed to mention the plants. Could it be that they were overlooking the plants?

Weeks later we stood in a forest study plot. "Do you see the difference?" I asked the student. "No," she exclaimed in a voice that revealed both frustration and perhaps embarrassment, "I don't!" I offered, "This oak leaf has rounded edges and is taller than it is wide; the maple is similar to the palm of your hand." She shook her head, "Still don't see it." I reassured her, "It will come, give it time." Each school year a similar conversation recurs; the faces change but the inability to recognize the leaves of common trees has become more prevalent. Even Pennsylvania's state tree, the Eastern Hemlock, seemed to elude recognition. The reasons for this type of pattern blindness intrigued me. Growing up in the hills of western Maryland where maples and oaks were engrained in childhood memories from long ago, I thought it strange that my students struggled with recognizing common leaves found in their backyards. Looking back I would not have guessed that years later

these initial observations would develop into my current action research project that utilizes restoration to combat this type of "blindness."

The problem seemed to be more than just the oversight of plants, it hindered science literacy and obstructed the basic understanding of ecosystems. This was apparent in the misinterpretation of diagrams and systems. When given figure 1 below and asked to explain how primary consumers get nitrogen, students often say that they get it from the atmosphere, when in reality it is obtained from the consumption of plants. Clearly there is a disconnection of information regarding the presence of plants in this cycle. They know that nitrogen exists in the atmosphere, is found in fertilizer, can be processed by a symbiotic relationship with bacteria, and that it is a main element of the protein in animals, but they ignore the presence and connection of plants, failing to understand the transfer of elements through the biogeochemical cycles.

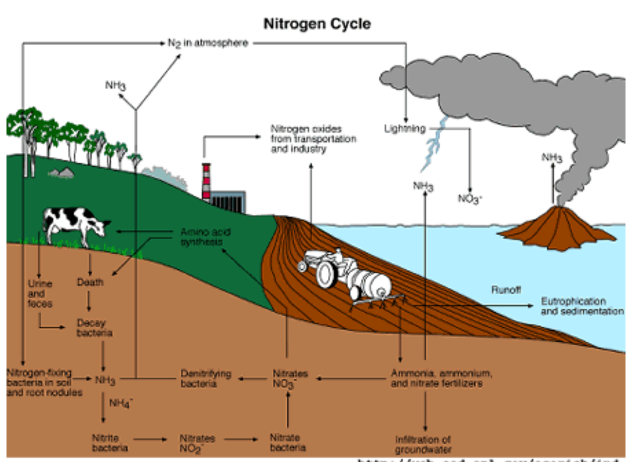


Figure 1. Nitrogen Cycle Diagram. Classroom discussions real that some students misinterpret the diagram by thinking that the cow inhaled Nitrogen and died. (The Environmental Literacy Council, 2008)

In order to address this problem in my classroom, I would first have to identify the why this occurs and secondly, how this type of preferential blindness can be corrected.

I enrolled in the UW-Madison Arboretum Department of Curriculum and Instruction Action Research: Implementation and Assessment for Restoration-Based Education course to improve teaching strategies and enhance learning in my rural Pennsylvania classroom. Having completed an Earth Partnership restoration course the previous summer, I saw great value in the lessons that incorporated hands-on activities and outdoor labs. In the past, project-based learning had proven to be both motivating and effective for my students attending Northwestern High School. Teaching in a rural school located near Lake Erie and surrounded by nature, I had always assumed that my students were immersed in fishing, hunting, and gardening. I naturally assumed that they were knowledgeable about the outdoors. Previous classroom observations proved otherwise, and the project component portion of the course offered an opportunity to examine the underlying reasons behind the pattern blindness I had observed in the forestry lab, animal preferred picture selection, and misinterpretation of a nitrogen cycle diagram. My project goal was to improved plant recognition and appreciation. I hoped that this would increase science literacy and perhaps enhance conservation efforts among my 11^{th} and twelfth grade students.

Problem Formulation

Recognizing and identifying a problem is not an easy task. Limited knowledge can skew our perceptions and understanding of the underlying issues that may result in a decrease in science literacy. Without science literacy it is impossible to appreciate the complex systems of nature. It is this appreciation that instills values and deeper thinking needed to preserve and restore ensure that our children and grandchildren will be able to enjoy them (WWF, 2012). Through course journaling and a collaborative method called Critical Friends and Reflective Questioning, the issue of "plant blindness" was mentioned as a possible underlying explanation of the observed learning trends. A literature review supported this idea and the initial research question was developed: *What are the emotional and cognitive gains for high school youth during a rain garden installation project?*

Due to time constraints, the project for the course would include the early phases of the project that involve the following achievable action research questions that focus specifically on the initial phases of the restoration project:

1) Determining the presence and severity of "plant blindness" in the test group. (Does "plant blindness" exist among 11^{th} & 12^{th} grade students at Northwestern High School?)
2) Determining the severity of plant blindness among 11^{th} & 12^{th} grade students at Northwestern High School (How extensive is the problem?)
3) Determining the cause (Why "plant blindness" exists at our school? or Where did the problem originate?)

4) Establish baseline and measure cognitive gains to combat plant blindness:
    a. What are the cognitive gains in math skills such as estimating, measuring, use of scale, and calculating area through garden design.
    b. What are the cognitive gains in science literacy evidenced by key term use in student discussions and student work?

Cognitive gains would be defined as increases in science literacy, math skills, and technology use. Assessment of cognitive gains would be accomplished through standardized testing involving closed and open-ended questions, teacher observation of performance based objectives, and student work. Emotional gains would include affective objectives dealing with values and attitudes toward class work and classmates, participation, motivation, and behavior. Emotional gains would be measured through journaling; teacher observation of body language, tone of voice, facial expression; voiced opinions during class discussions; student interviews, and surveys.

Literature Review

Autotrophy, the ability to make one's own food, in plants involves perhaps the most amazing and important chemical reaction that occurs on earth. Through photosynthesis plants capture the sun's energy and transform it into sugars that they not only store for themselves, but in turn directly and indirectly support the many organisms that inhabit the earth through biogeochemical cycles (Ballantyne, Menge, Ostling, and Hosseini, 2008). Yet somehow we manage to look past the plants, or even push them aside as trample through the forest to seek out the next bird on our *Audubon Watchlist*. Natalie Angier wrote about this phenomenon in a 2007 *New York Times* article and claims that if you "show someone a painting of a verdant, botanically explicit forest with three elk grazing in the middle and ask what the picture is about, and the average viewer will answer, 'Three elk grazing,'" (Angier, 2007). Natalie Angier was referring to the work of Dr. James H. Wandersee from Louisiana State University and Elizabeth Schussler (1998) where they defined plant blindness as

> "*the inability to see or notice the plants in one's own environment—leading to:*
> *(a) the inability to recognize the importance of plants in the biosphere, and in human affairs;*
> *(b) the inability to appreciate the aesthetic and unique biological features of the life forms belonging to the Plant Kingdom; and*
> (c) *the misguided, anthropocentric ranking of plants as inferior to animals, leading to the erroneous conclusion that they are unworthy of human consideration*."

Concerned with this "*zoocentric*" behavior, Nurettin Yorek investigated how students utilize perceived characteristics of living organisms in order to classify them. Yorek found that first year high school students from seven schools in Izmir, Turkey identified living mainly with being human. According to the surveyed students the most identifying characteristic of living organisms is movement. (Yorek, 2009). In practice I too have heard this response during preliminary discussions and assessments preceding instruction of the characteristics of life. Yorek coins this as the Animistic-Anthropocentric Construction of Life Concept.

Are we just innately distracted by animals, their movements and sounds, as some evolutionary survival plan, or are we taught from the beginning to, look at the bird, hold the kitten, read about Franklin the turtle, and write a report on an endangered animal? Remembering back to one of my favorite childhood magazines, *Ranger Rick*, I believe these "*zoochauvanistic*" attitudes may be influenced during our early days. Many studies have been conducted in an attempt to gain insight into this question. Melanie Link-Perez et al. (2010) published the results in an *International Journal of Science Education* article entitled, "What's in a Name: Differential Labeling of Plant and Animal Photographs in Two Nationally-Syndicated Elementary Science Textbook Series," she found that plants were under represented in comparison to animals using general names rather than specific names. Her research team, "recommends that educators go beyond the textbooks to expose students to a diversity of named plants, and present plants as distinct organisms rather than as a collection of parts" (Link-Perez, Dollo, Weber, & Schussler, 2010)

Elisabeth Schussler, an assistant professor at Miami University's Department of Botany, continues to investigate the reasons behind plant blindness; she currently tests the hypothesis, "that human are less likely to pay attention to plants because of differences in their spatial distribution, movement over time, color, perceived danger, and familiarity as compared to animals" (Schussler, 2008). Many of her studies focus specifically on students' familiarity of plants through children's books, educational textbooks, the undergraduate development of the nature of science, and the underlying philosophy or value of science that affect how we come to know what we know in science. On her website see states, "the ultimate goal is to develop novel curricula to combat this inherent plant blindness of students" (Schussler, 2012).

Can it be corrected? According to James H. Wandersee (2010) "seeing" is not just a product of the information that enters the eye, but rather a personal interpretation based upon what he calls, "default values." This appears to be particularly common in developed nations; most people view plants as a, "blurry green backdrop." In order for us to see something or bring it to our conscience attention, Wandersee (2010) says that it must have "prior meaning." After conducting plant blindness research studies at Louisiana State University he concluded, " that it is only through botanical education, plant mentorship, and direct experience that plants become salient, meaningful, and valued by the US citizenry" (Wandersee and Clary, 2010). Establishing lasting positive student attitudes

towards plants through outdoor activities can been achieved regardless of whether students had prior gardening experience (Fancovicova, & Prokop, 2011). This research seems supported and evidenced in everyday observations; if someone you are fond of sends you flowers, not only would you notice the flowers, but also you would attach meaning and emotion to the flowers. You would recognize the flowers as being familiar and depending upon how the relationship ended, may have good or bad feelings toward the flowers. Growing up I distinctly remember the snowball bush in front of my Great Grandmother's home, and have learned many of the varieties of vegetables and flowers from gardening with my parents. As educators we are given the opportunity to not only educate students about content and curriculum, but to develop curricula and utilize strategies that will aid in the recall of information to provide a foundation for which more information can be anchored. In my classroom, like most throughout the world, I teach a variety of individuals. Learning style surveys, student interviews, class discussions, and informal classroom observations all indicate that motivation, prior learning experiences, and values vary greatly among students. If plant blindness does exists in my students at Northwestern High School, I believe that a rain garden restoration project would contain the essential components needed to combat plant blindness in students.

Data Analysis

Based upon articles and websites introducing these phenomena, I chose to design a digital online picture pre-survey to test for the presence of plant blindness. Prior to the onset of the restoration project, this free-response picture pre-survey was administered to 65 11th and 12th grade students enrolled in an integrated science course at Northwestern High School located in Albion, Pennsylvania. Pictures of elephants were located using a Google image search; to include the pictures in the online survey the link to the image was copied and embedded in the Quia online survey. It is important to note that specific images were chosen to determine if the "plant blindness" existed in the study group, and also to gain an understanding of the variables that may influence the extent of plant blindness. A total of four pictures were selected. The first picture included two elephants in a grassland habitat (see figure 3). The second picture also included two elephants but in a green grassy environment with trees in the fenced background. Pictures 1 and 2 differ in the brown vs. green background; this is to investigate a color variable. Picture 3 depicts an elephant reaching for leaves on a tree; this picture was chosen to measure whether students would notice an interaction between plants and animals based upon previous food chain knowledge. Picture 4 was chosen because the clearly the photographer chose to place emphasis on the plant; in this picture the plant is front, center, and larger than the animals.

Short answer free-responses from students were read to identify trends and patterns in the data; these trends / patterns became the categories by which responses would be sorted. Using the matrix method of analysis, the categories

were listed across the top row of the matrix and are as follows: student response mentions plant(s), student response mentions animal(s), student response mentions both plant(s) and animal(s), student response included an affective response, and student response describes an interaction between the animal(s) and plant(s) / habitat (see Appendix A).

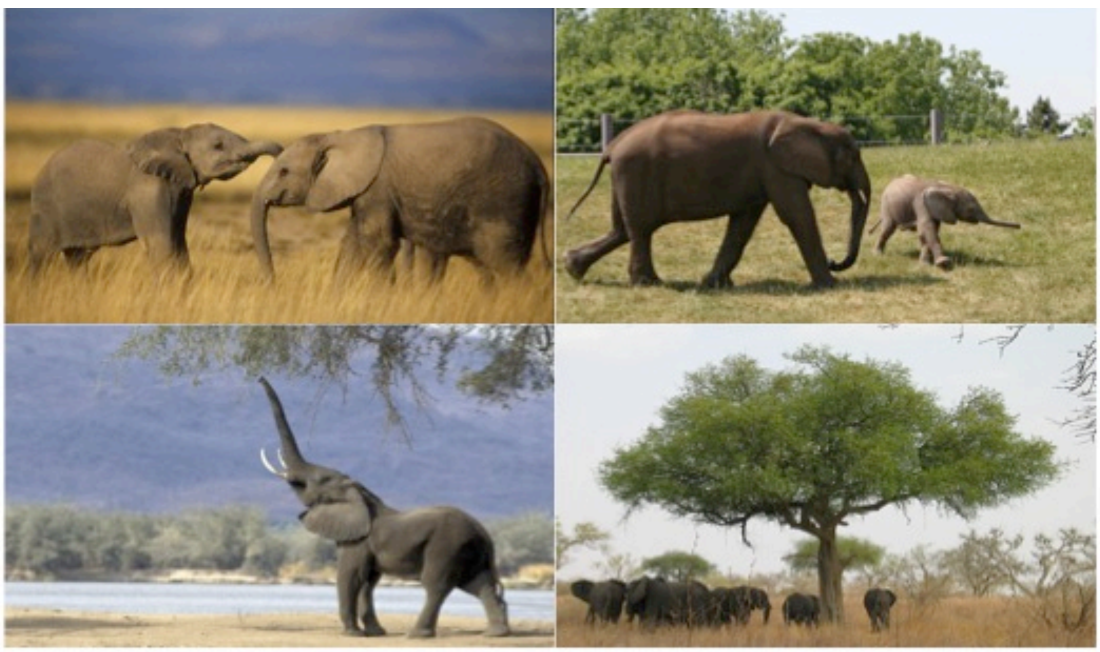


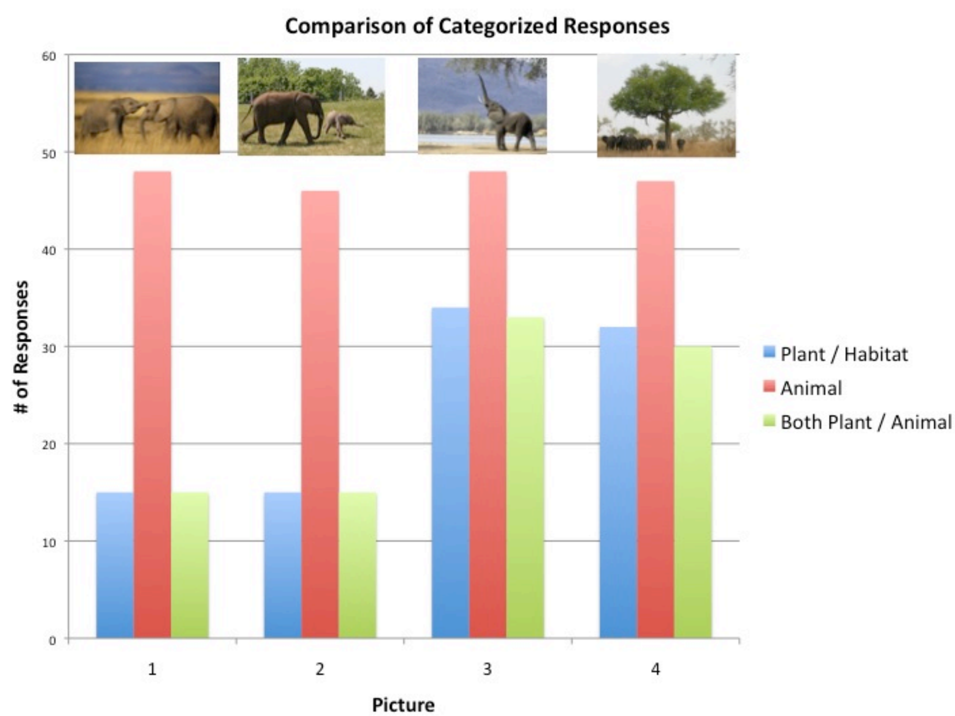
Figure 1. Chosen pictures for pre survey. Picture 1 is shown in the upper left corner. Picture 2 is in the upper right corner, Picture 3 in the lower left and Picture 4 in the lower right.

Each response was then listed in the first column and analyzed for evidence to indicate the observation of plants, animals, and environment. A “1” was placed in the corresponding category if the condition was met. To analyze the results using the matrix each identified category was summed and the sum was graphed (see figure 3).

Student Response	Mentions plant	Mentions Animal	Mentions Both Plant & Animal	Affective response	interaction between the animal(s) and plant(s) / habitat
2 elephants		1			
elephants and fields	1	1	1		
But momma, I don't want to let the Safari goers see me				1	
An elephants eating habit.	1	1	1		1

Table 1. Example Student Responses and Categorized Within the Matrix.

The comparison graph of the student free-responses for the picture pre-survey indicated that students consistently demonstrated the observation of the animal present in the photo (see figure 3 below). This observation dominated the trends observed in the responses regardless of the image.



Photos that displayed an interaction of the animal with its environment (Picture 3) or pictures where the main focus of the picture was a plant, as seen in picture 4 where the tree is in the foreground and the elephants are small in size, the students were more apt to notice the plant or the habitat (see figure 4 above). Overall responses including those in the affective category are graphed below in figure 5.

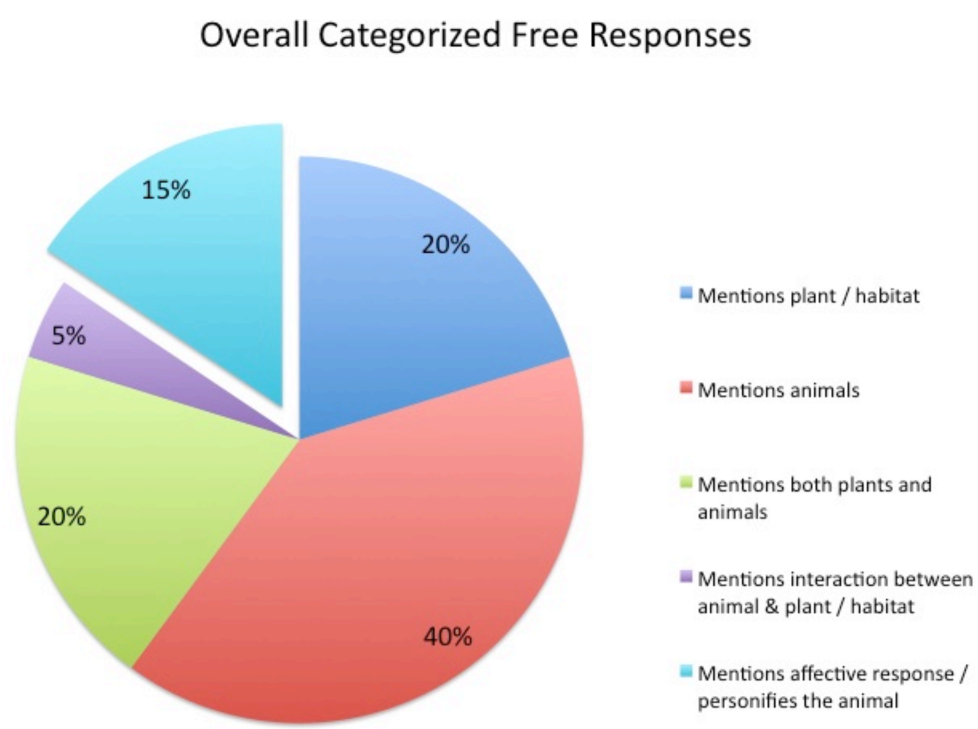


Figure 5. Overall Categorized Free Responses

Student Response to Closed-ended Questions

To get a feel for the prior experience of the students involved in the study, the question, "How would you best describe the location of your residence?" was asked; possible multiple choice answers included the following:

- In town with a yard
- In town without a yard
- Suburb
- Rural with a yard
- Rural without a yard
- Rural on a farm

74% of students replied that they have a yard regardless of whether they live in town or in a rural are. 18% report living on a farm. This leaves only 8% of student who do not have a residence with yard or farmland. Theses results are graphed below (see figure 5).

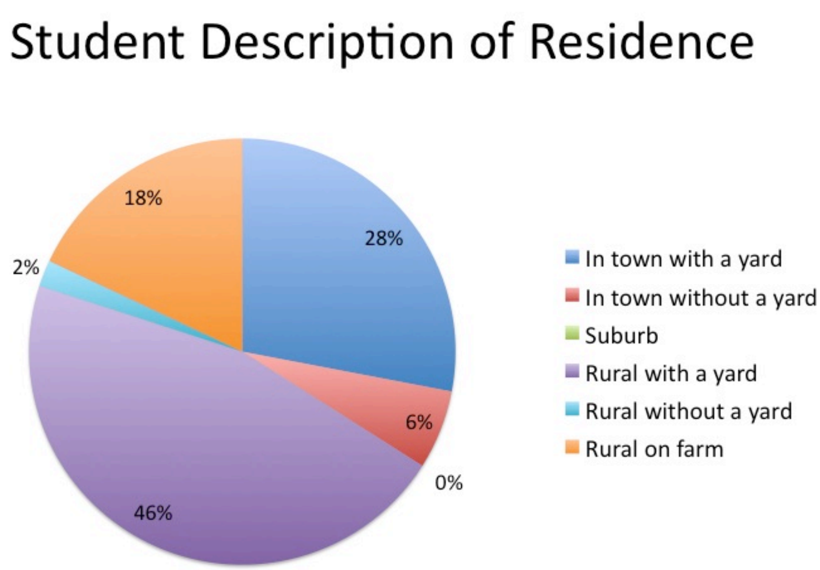


Figure 5. How students describe where they live.

To measure the preference of animals verses plants, students were asked two separate questions involving why they would like to visit the zoo. During their tenth grade year the study group of students would have attended a field trip to the Cleveland Zoo, and should be familiar with the Rainforest building exhibit as well as the greenhouse. Students chose overwhelmingly "strongly agree" for a visit to the zoo to see the animals. Regarding a visit to see the plants, opinions were somewhat mixed. This perhaps indicates that some would like to see the plants, others may simply want to visit the zoo (see figure 6).

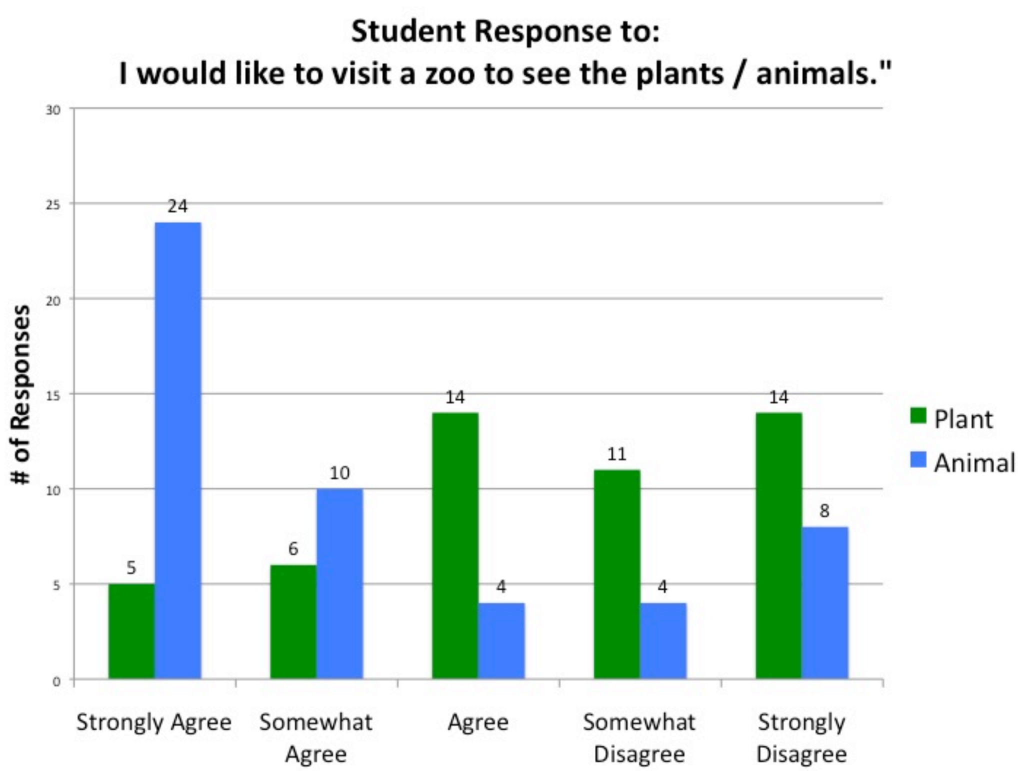


Figure 6. Responses to the Visit to the Zoo Question.

To gain further insight on student interest and preference I asked students to respond the survey questions: "I would like to visit a rainforest to see the plants." and "I would like to visit a rainforest to see the animals." The results are shown in

the graph below (see figure 7). The majority of students indicated that they strongly agree that they would visit the rainforest to see animals. Surprisingly a large number of students responded that they "strongly disagreed" with the statement, "I would like to visit the rainforest to see the plants." Having recently visited a rainforest last summer and having spent much of the time observing plants, I was a little disappointed at their disinterest.

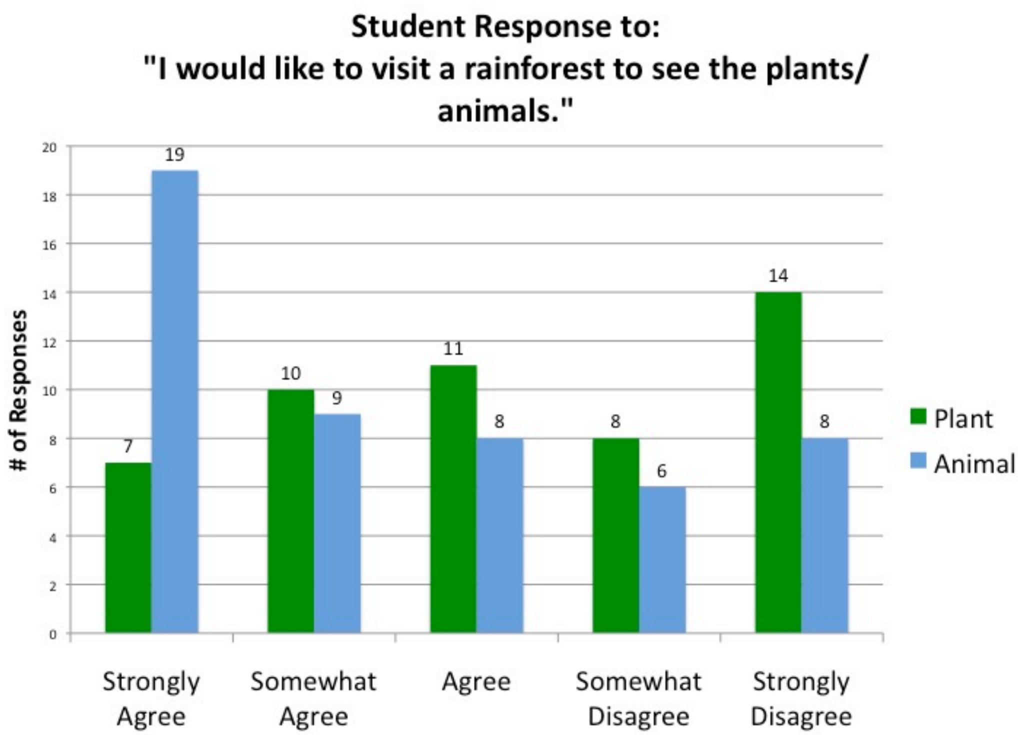


Figure 7.Responses to a visit to the Rainforest.

Cognitive Math Assessment

Previously in the school year while examining standardized test scores, I noted a deficiency in the students' ability to calculate the area for geometric shapes. This question is often posed as an open-ended problem that includes a labeled diagram of the shape. Four shapes (parallelogram, square, pentagon and circle)

were chosen to pre-assess this math objective. Students were instructed to work individually and were provided a list of formulas which included area formulas for may geometric shapes. Student calculated answers were scored and tallied based upon the correct numerical number, the correct unit, and both the correct unit and numerical answer; the results are seen in figure 8 below.

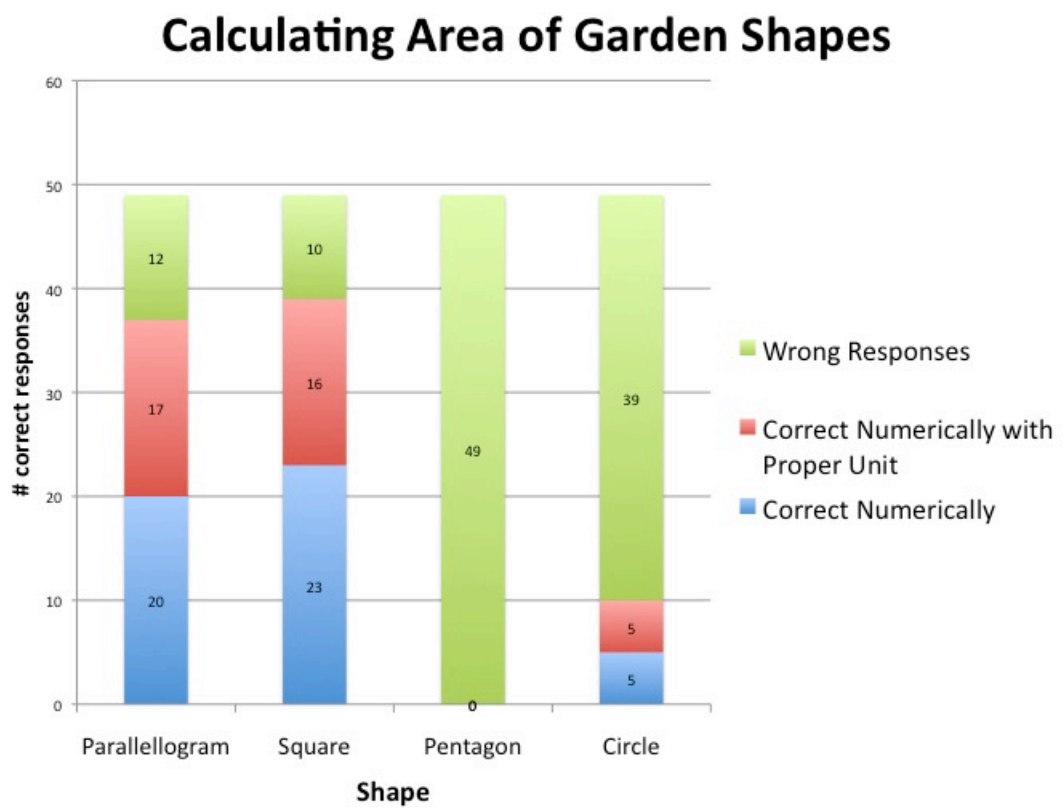


Figure 8. Pre-assessment math results for calculating the area of figures.

Students were somewhat successful in the calculation of area in the pre-assessment for the parallelogram and square, but seemed to be confused about the pentagon and the circle calculations.

Taking Action:

Based upon the results from the survey implementation of the plans to incorporate a hands-on garden design project began.

Teacher classroom observations and student work indicate an increase in student recall of units and appropriate formulas for calculating area. All students through a review lesson and support were successfully able to calculate the area of the shapes. Students informally interviewed indicated that they had a better understanding of area and thought the exercise had value in the real world for calculating how much mulch you would need to cover a flower garden. This was noted as a positive gain for increasing math awareness, comfort, and value.

Classroom observations revealed positive attitudes and overall cooperation throughout the design process of the garden. Students seemed eager to get to class, smiled as they entered the room, and were quick to get materials and begin their work. The lessons involved on site visits to the area that was to be restored as indicated in figure 9 below.

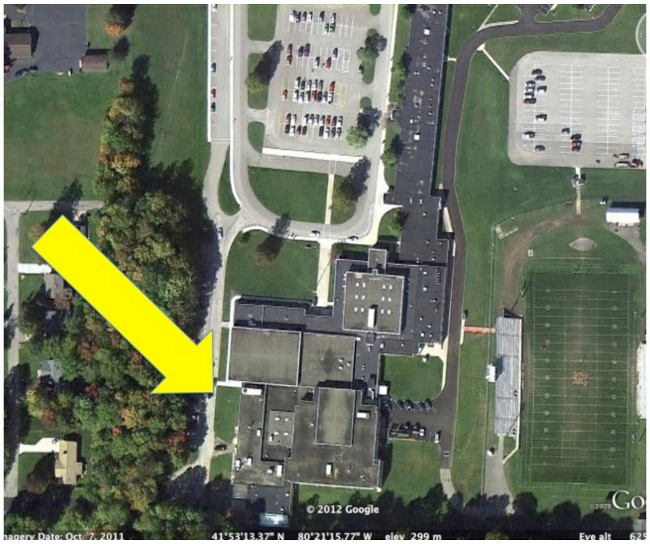


Figure 9. Areal view of the site.

A closer look at the site at ground level can be seen in figures 10 and 11 below.

Figure 10. Study Site Facing southeast.

Figure 11. Study Site Facing Northeast

Other cognitive gains were observed during the fieldwork collection of measurement used to calculate a to-scale map. Students were able to successfully demonstrate the ability to collect date through the use of a 100' tape and to estimate the angles of the corners (see figure 12). Interesting substantive conversations included noted key vocabulary such as perpendicular, parallel, slope, rise, run, area, right angle, obtuse, acute, and square feet. Inquiry and deeper analytical thinking were also evidenced through student discussions about the changing angle of the sun, direction of north, and intensity of light as it changes throughout the day and seasons.

Figure 12. Students use tape measures to accurately measure the area. This information was used to calculate the area of the site and collaborated to produce a to-scale map.

Students were asked to rough sketch the study site, label key features, and record the dimensions. Upon returning inside students were asked to collaboratively produce a similar rough sketch of the gathered information on the classroom whiteboard. Figure 13 shows the production of the "collaborated class map."

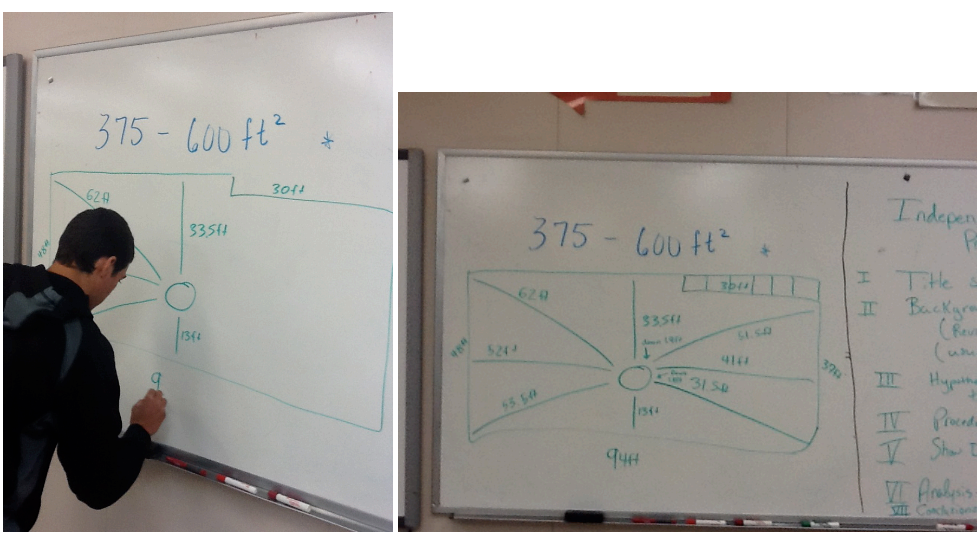


Figure 13. Production of Collaborated Class Map.

A photo of this map was uploaded to the class Wiki to allow students with learning disabilities to receive additional support and time to complete their individual map. Individual maps were created using graph paper and by establishing a scale of 1 block is equal to 3 ft. An successful example of an individual student map is shown in figure 14.

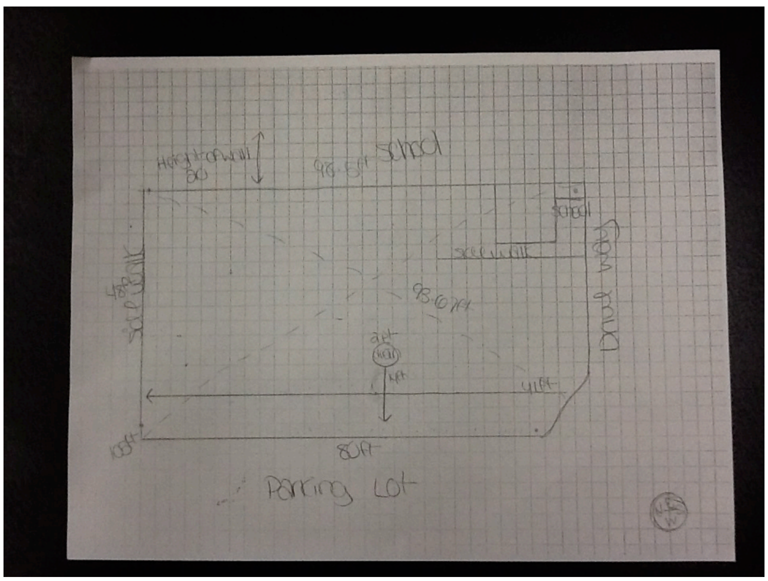
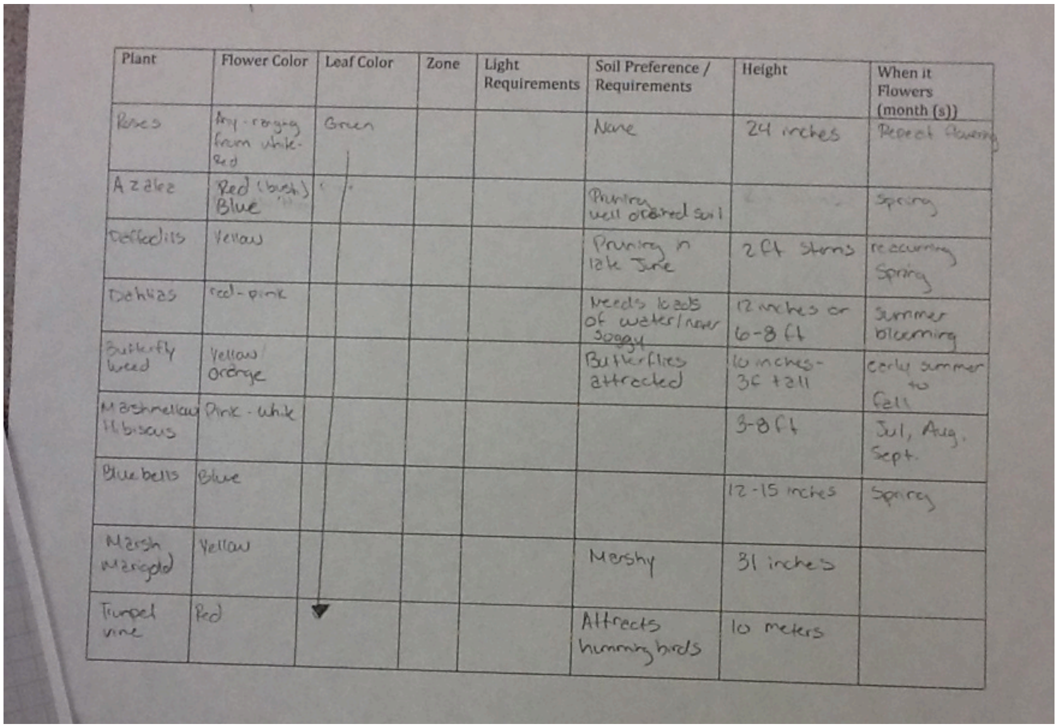


Figure 14. Completed student to-scale drawing of the study site.

Figure 15. Individual sketch including color schema and design components, indicative of the application of creativity, synthesis, and innovation- all STEM related 21st Century Skills.



Plant	Flower Color	Leaf Color	Zone	Light Requirements	Soil Preference / Requirements	Height	When it Flowers (month (s))
Roses	Any - ranging from white - Red	Green			None	24 inches	Repeat flowering
Azalea	Red (bush) Blue				Pruning well drained soil		Spring
Daffodils	Yellow				Pruning in late June	2 ft stems	reoccurring Spring
Dahlias	red - pink				Needs loads of water / never soggy	12 inches or 6-8 ft	Summer blooming
Butterfly weed	Yellow / orange				Butterflies attracted	10 inches - 3f tall	early summer to fall
Marshmellow Hibiscus	Pink - white					3-8 ft	Jul, Aug, Sept.
Blue bells	Blue					12-15 inches	Spring
Marsh marigold	Yellow				Mushy	31 inches	
Trumpet vine	Red				Attracts humming birds	10 meters	

Figure 16. Individual student work showing plant selection for proposed garden.

Students were asked to use on line data bases to match the chosen color scheme, and taking into consideration the zone, leaf requirements, soil preference, height, and flowing period. At this time many students are still researching to complete this worksheet. In order to complete the process students will evaluate the chosen flower to ensure that there is color throughout the growing period designated as April to October. This task requires higher level thinking skills such as categorization, synthesis, analysis, and evaluation. It also required the student to organize information to complete a data table. Because students used databases to find the information, they successfully displayed 21st Century skills using web2 tools.

Overall there were substantial emotional and cognitive gains throughout this initial process. Best evidence was provided in the observations of student

engagement that directly relates to interest in the designing of the rain garden. Students have developed a working knowledge of the plants they chose to put in their gardens. In the post survey they will estimate the increase in the ability to identify plants. By chance my administrator formally observed me, and it should be noted that his comments included the incredible engagement and enthusiasm of the students during the outdoor lab.

Continued Action Plan: Timeline

June:

Administer post surveys to assess initial stages of the garden design phase. Tis test will include questions specific to decreases in plant blindness.

In order to complete the garden prior to the August Earth Partnership Symposium, I have arranged for the Master Gardeners to provide plants and help on June 16th with a rain date on June 23rd. The study group will finish the final evaluation of the site and all garden proposals will be considered for the area.

Students who are planting the garden over the summer will be pre & post surveyed to document cognitive & emotional gains to combat plant blindness.

Recruit & organize for students to come and record pollinators. These students will need to take a pre –assessment to assess their knowledge concerning the identification of pollinators (I have to develop this yet). A post test will be given at the end.

July

Presentation will be updated prior to the Symposium.

August

Symposium presentation

September / October

Update webpage with summer pollinator data and continue to monitor through fall.

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Appendix